the health implications of climate change and the science that will help us adapt to these challenges.

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Roger Glass
Joshua Rosenthal
Christine M. Jessup
Fogarty International Center
National Institutes of Health
Department of Health and Human Services
Bethesda, Maryland
E-mail: joshua_rosenthal@nih.gov

Linda Birnbaum
Chris Portier
National Institute of Environmental Health Sciences
National Institutes of Health
Department of Health and Human Services
Research Triangle Park, North Carolina

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Editor's note: In accordance with journal policy, Ebi et al. were asked whether they wanted to respond to this letter, but they chose not to do so.

Lead Exposures from Car Batteries—A Global Problem

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In "Mass Lead Intoxication from Informal Used Lead Acid Battery Recycling in Dakar, Senegal," Haefliger et al. (2009) described a problem throughout the developing world that is both tragic and only now beginning to be understood with respect to its extent and effect.

Eighteen children (and more since) died from acute lead poisoning in late 2008 in Dakar. These poisonings occurred because the individuals recycling car batteries melted slag without appropriate controls and without having any understanding of the toxicity of lead. Most of these recyclers were women who brought their children to their work sites without knowing the risks.

These problems are not restricted to Senegal. Without much effort, investigators from Blacksmith Institute have identified another 22 sites worldwide that are similar to this one. The identified sites are in cities in poor countries, especially in the tropics (e.g., the Dominican Republic, Philippines, Panama, El Salvador, Guatemala, India, Ghana, Jamaica) (Blacksmith Institute 2009).

Epidemiologic studies of exposed populations, such as the one in Senegal reported by Haefliger et al. (2009), are urgently needed to characterize exposures and identify related health effects. An earlier example of such a study was conducted in the Dominican Republic at Haina (also known as Bajos de Haina), which has been called the "Dominican Chernobyl." This community is near an abandoned lead-acid battery recycling smelter, and most of the residents showed signs of lead poisoning.

The Haina site, as well as the surrounding area, was the scene of severe lead poisoning in the 1990s. In March 1997, 116 children were surveyed, and 146 children were surveyed in August 1997. Mean blood lead concentrations were 71 μg/dL (range, 9–234 μg/dL) in March and 32 μg/dL (range, 6–130 μg/dL) in August (Kaul et al. 1999). The study revealed that at least 28% of the children required immediate treatment and 5% had lead levels > 79 μg/dL, putting them at risk for severe neurologic sequelae at the time of the study. In the United States, the action level for blood lead concentration is 10 μg/dL (Centers for Disease Control and Prevention 2007; U.S. Environmental Protection Agency 2000).

The scientific findings from Haina (Kaul et al. 1999) drove a collaborative cleanup of this site, which has recently been completed. The Blacksmith Institute helped locate funding, worked closely with local authorities, and provided technical assistance to assure the cleanup was adequate. We are currently beginning a similar cleanup project in Dakar, at the site studied by Haefliger et al. (2009).

Almost all large urban centers in the developing world have a problem with recycling used lead acid batteries, and hundreds of thousands, if not millions, of children are exposed to lead from battery recycling. In humid conditions, car batteries need to be replaced every 2 or 3 years, and car use is increasing throughout the world, which will result in even more used batteries. Thus, this problem deserves our immediate and serious attention.

Blacksmith Institute, a registered 501(c)3 non-profit organization, is committed to solving pollution problems around the world. R.F. is the founder and president of Blacksmith Institute.

Richard Fuller
Blacksmith Institute
New York, New York
E-mail: fuller@blacksmithinstitute.org

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Editor's note: In accordance with journal policy, Haefliger et al. were asked whether they wanted to respond to this letter, but they chose not to do so.

Periodontal Disease and Environmental Cadmium Exposure

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We were pleased to see the article by Arora et al. (2009), which describes an association between environmental exposure to cadmium and periodontal disease.

In their cross-sectional study among U.S. adults, Arora et al. (2009) found periodontal disease in 15.4% of a nationally representative sample of 11,412 participants. The authors reported that for individuals with periodontal disease, as defined in their study, the geometric mean concentration of urinary Cd (0.50 μg/g creatinine) was significantly higher than for persons with no evidence of periodontitis (0.30 μg/g creatinine).

Arora et al. (2009) correctly stated that the main source of human exposure to environmental Cd is smoking. They proposed that additional sources of Cd in the general population are "emissions from industrial activities, including mining, smelting, and manufacturing of batteries, pigments, stabilizers, and alloys" (Arora et al. 2009).

However, in our view, one Cd source has been overlooked: intraoral dental alloys. Individuals with dental alloy restorations are regularly exposed to a number of trace elements that are continuously released from intraoral alloys (Wataha 2000).

Cadmium may be released from intraoral alloys in dental patients and may be accumulated in both teeth and oral tissues, binding tightly to metallothioneins (Goyer and Clarkson 2001; Munksgaard 1992).

For example, the intermetallic compound dental amalgam may contain approximately 4.5 µg/g Cd in the metal–matrix alloy (Minoia et al. 2007). Two metals other than Cd—lead (Dye et al. 2002) and mercury (Trivedi and Talim 1973)—probably contribute to periodontitis.

In a study of 268 avulsed teeth analyzed by atomic absorption spectrometry, Alomary et al. (2006) reported that the levels of Cd in tooth specimens were significantly higher in samples with dental amalgam fillings than in teeth with no amalgam. These findings suggest that exposure to Cd released from dental alloy restorations may influence many aspects of mineralized hard tissue of teeth and their immediate surrounding periodontal tissues. Another potential source of Cd is a metal dental bridge in which a Cd-containing alloy has been used for soldering.

In rare cases, Cd-containing dental alloys may lead to systemic intoxication (Borowiak et al. 1990). Even in dental acrylic-based resin for removable dentures, Cd might be used as a pigment.

It is therefore plausible that the release of Cd from both metal and/or nonmetal dental materials (i.e., resin-based materials) into the oral cavity may contribute to periodontal disease among adults.

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Gianpaolo Guzzi
Italian Association for Metals and Biocompatibility Research–A.I.R.M.E.B.
Milan, Italy
E-mail: gianpaolo_guzzi@fastwebnet.it

Paolo D. Pigatto
Department of Technology for Health
Dermatological Clinic
IRCCS Galeazzi Hospital
University of Milan
Milan, Italy

Anna Ronchi
Claudio Minoia
Laboratory of Environmental and Toxicology Testing
"S. Maugeri"-IRCCS
Pavia, Italy

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Environmental Cadmium: Arora et al. Respond

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We thank Guzzi et al. for their interest in our study on the association of environmental cadmium exposure and periodontal disease (Arora et al. 2009). There are a number of environmental sources of Cd in the U.S. population, with tobacco smoke being recognized as a major contributor (Paschal et al. 2000). In our study, we used creatinine-corrected urinary Cd concentrations to estimate long-term cumulative Cd exposure. This biomarker of Cd body burden encompasses an individual's exposure to Cd from all sources; if dental restorative materials are indeed a source of Cd, then their contribution would also have been captured in our study.

That dental amalgams are the major source of Cd body burden has been questioned (Koh and Koh 2007), and further study is needed to determine the relative contribution of dental restorative materials to Cd exposure in the U.S. population. It is well recognized that the composition of dental amalgams and metal alloys used in dental restorations varies with type of restorative material and with the processes and standards of manufacture (Powers and Sakaguchi 2006). It therefore remains unclear whether any possible release of Cd from dental restorations would contribute significantly to the risk of periodontal disease.

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Manish Arora
Population Oral Health
University of Sydney
Sydney, New South Wales, Australia
E-mail: marora@usyd.edu.au

Jennifer Weuve
Joel Schwartz
Robert O. Wright
Environmental and Occupational Medicine and Epidemiology
Harvard School of Public Health
Boston, Massachusetts

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Erratum

In the October 2009 article "Learning Curve: Putting Healthy School Principles into Practice" [Environ Health Perspect 117:A448–A453 (2009)], William Orr is quoted but never fully identified by name. Orr is executive director of the Collaborative for High Performance Schools. *EHP* regrets the omission.